

кадры инновационной России» на 2009–2013 гг., «Проведение научных исследований коллективами под руководством приглашенных исследователей», направлено именно на поддержку российских ученых, желающих вернуться в Россию. Целью этого мероприятия является развитие устойчивого и эффективного взаимодействия с российскими учеными, работающими за рубежом на постоянной и временной основе, закрепления их в российской науке и образовании, использование их опыта, навыков и знаний для развития отечественной системы науки, образования и высоких технологий. В рамках этого мероприятия в 2009-2012 гг. производится ежегодный отбор около 100

проектов научных исследований коллективами под руководством приглашенных исследователей с объемом финансового обеспечения из средств федерального бюджета до 2 млн. рублей в год каждый.

Таким образом, для решения задач модернизации российской экономики и укрепления интеллектуального потенциала страны следует обращать приоритетное внимание не столько на сокращение эмиграции российских исследователей, сколько на оптимизацию размеров и форм этой миграции.

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#### SELF-ORGANIZING ECONOMIC SYSTEM: THE MODEL AND ITS APPLICATION

All economic systems, including national economies, markets and enterprises, are trying to achieve sustainability and adaptability. How can it be achieved in a context of increasing complexity and instability of the economic environment? It is possible due to the structure and functions of the economic system.

In economic cybernetic the model of adaptive-control system is used. The adaptation process is carried out by the inclusion of two levels of negative feedback in the model.

But the adaptive control system is not self-organizing. Why? - In the adaptive control system the regulatory body controls all operations of the executive mechanisms. The actions of each executive mechanism are pre-planned and strictly governed. In case of increasing fluctuations and in the extremely unstable state the elements (executive mechanisms) can't organize themselves and transform the system, they don't have such a "right".

In Synergetics the general patterns of the self-organization, development of the system are considered. But in Synergetics, unlike Cybernetics, the mechanism of the system functioning is not considered.

Therefore the task was to develop the model of economic self-organizing system based on Cybernetics and Synergetics, moreover to use the Cybernetics in the part where it does not contradict the Synergetics to provide a mechanism for self-organization.

Since it is economic model, then to create it the economic theory is used, in particular Institutionalism, Schumpeter's theory, theory of Tugan-Baranovsky.

#### The structural-functional model of self-organizing economic system

Fig. 1 shows the structural-functional model of self-organizing economic system.

**The elements** are economic subjects (individuals, entrepreneurs, and companies) engaged in economic interaction according to the rules.

**Current rules** are the institutions that govern the current interaction of economic subjects.

**Strategic rules** are the institutions of the economic system in general, the institutions of the adaptation, i.e. the rules of changing the current rules.

**The direct connections (or object)** are the current interaction of economic subjects, the exchange. To provide self-organization the direct connections are carried out on the basis of *the principle of competition*.

**Operational negative feedback** obeys current rules and compensates deviations of the system on the basis of incoming information. Its function is support of the processes and structure of economic interaction, using *the principle of control* of the rules execution by economic subjects.

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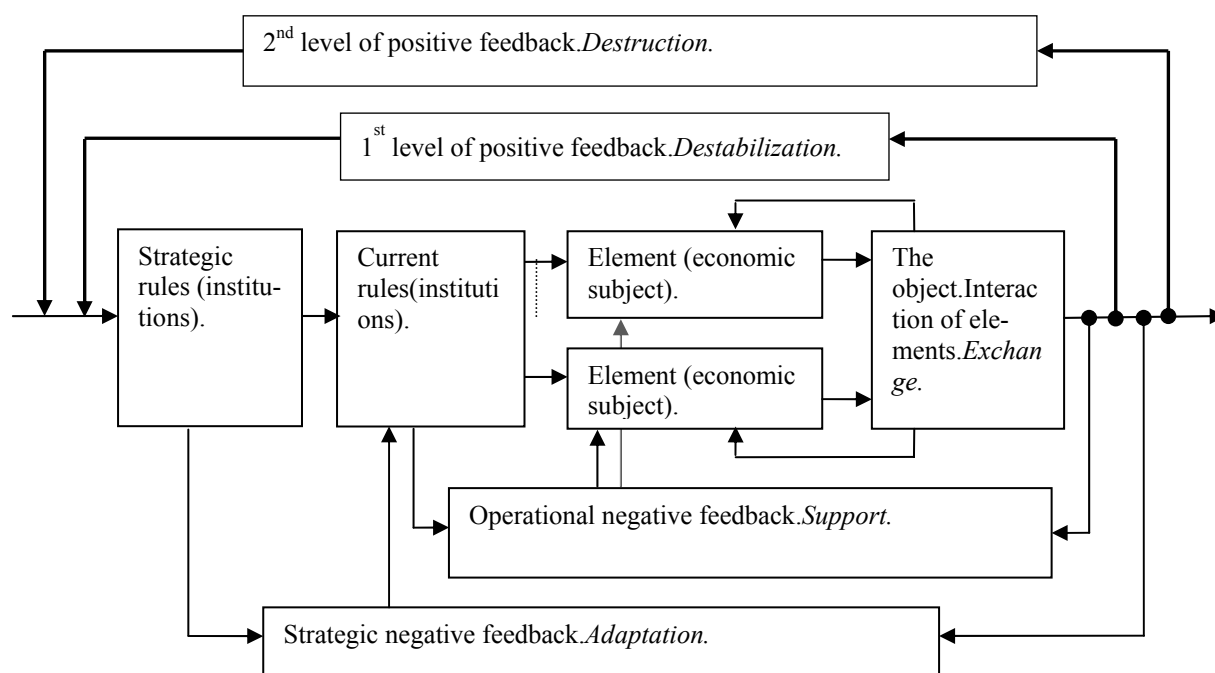


Fig. 1. The structural-functional model of self-organizing economic system

The function of **strategic negative feedback** it is the adaptation of institutions and structure of the economic system to the changing conditions of the external and internal environment, by changing the current rules. In self-organizing system the strategic negative feedback is based on *the principle of cooperation*. It means the inclusion of the economic subjects in the process of making new rules, in the process of adaptation.

Positive feedback it is a process of influence of previously unrecorded external and internal fluctuations, which lead to an increase in the number of new fluctuations (deviations) in the system such as an autocatalytic reaction, which create a threat of the system destruction.

The first level of positive feedback - this is unrecorded deviations, the causes of which are internal or external fluctuations. Feature of these deviations is that they lead to destabilization of the economic system and then to the need of adaptation. *The action principle it is conflict.*

The second level of positive feedback it is also unrecorded deviations in the work of the economic system, which create a threat of the system destruction and cause the need of self-organization of the economic subjects (elements). This is the cause of dissipative structures.

Dissipative structures it is the new systems within the previous system, arising from the positive feedback. Dissipative structures are cre-

ated by economic subjects that generate the new rules of interaction. The formation of dissipative structures it is a process of self-organization; it is the synthesis of innovations in the economy.

Between dissipative structures (innovations) and the old system the fight for the elements (for market) may arise. As a result of competition the choice in favor of a certain dissipative structure is carried out, the bifurcation point occurs - the point of no return the system to the previous structure and principles of the organization.

The phase transition it is the process of distribution of dissipative structure in the old system. According to Schumpeter it is the process of "creative destruction". The introduction of the dissipative structure is based on the principles of competition, control, cooperation and conflict, as the autocatalytic reaction.

Table 1 shows the classification of subsystems of direct connections, negative and positive feedbacks of self-organizing system.

The model of self-organizing economic system is being tested and used in practice in Russia for the following projects: Electronic commodity market system "System of electronic sales", Electronic external legally significant document circulation system, System of efficient accommodation management (for homeowner associations).

Table 1

Functions and principles of the self-organizing economic system

	Subsystem	Function (why?)	Principle of interaction (how?)
1.	Direct relations	Exchange	Competition
2.	Operational negative feedback	Support	Control
3.	Strategic negative feedback	Adaptation	Cooperation
4.	First level of positive feedback	Destabilization	Conflict
5.	Second level of positive feedback	Destruction	Conflict

**Application of the model of self-organizing economic system to Electronic commodity market system**

In this paper we are considering the project Electronic commodity market system “System of electronic sales”.

The main objective of the project is to reduce costs of market transactions, without displacing of the market relations.

Electronic commodity market system is developed primarily for agricultural markets, in particular, for the markets of cereals and cereal products. This is due to the specialization of the Omsk region. For example, in the Omsk region annually is produced about 4 million tons of grain, is consumed less than 2 million tons.

During development it became clear that it is necessary to create not only a regional trading system for food market, but the Electronic commodity market system for the Russian Federation, than then for the international market.

The reasons are following:

- Food is often exported outside the region, where it is produced.
- Farmer or grain producer wants to sell the grain as well as to buy some industrial and agricultural goods (petrol, diesel, spare parts, agricultural machinery, seeds, fertilizers, etc.).
- In addition to the buyer and seller in

transactions are involved banks, warehouses, freight forwarders, carriers, insurance companies, etc.

Project “System of Electronic Sales” is a development of the automated control system (ACS) as well as organizational and legal structure of the Electronic commodity market system.

*Automated control system of commodity market*

Automated control system is developed on the basis of the formalized description of relations, elements and processes of the automation object (commodity market).

Elements of the automated control system of the commodity market are buyer, seller, and so-called functional elements: bank, warehouse, freight forwarder, carrier, insurer, etc.

Commodity market relations are the market transactions. The market transaction is described by its parameters: goods, form of trade, level of trade, input and output. Specific description of goods, form of trade, level of trade and territory should be incorporated into the relevant classifications.

Thus, in the Electronic commodity market system the following principle for constructing segments of the commodity market is defined (Table 2).

Table 2

Commodity market segment

Segment	Goods (group of goods)	Soft Red Winter, grade 3, bio
	Trade form	Trading (Forward)
	Trade level	Interregional (Omsk region, Altai region)

Each segment corresponds to certain current formalized rules of economic exchange. Within the segment the homogeneous market transactions are being implemented. Formalized rules of the

segment describe not only the structure of the market relation, but also its implementation.

The process of implementation (execution algorithm) of market relations in the ACS of the

commodity market it is a sequence of economic procedures, providing a full cycle of trade in electronic form. In the Electronic commodity market system the algorithm of market transactions implementation is fully automated – from organization of interaction to conclusion of transaction and control of its implementation.

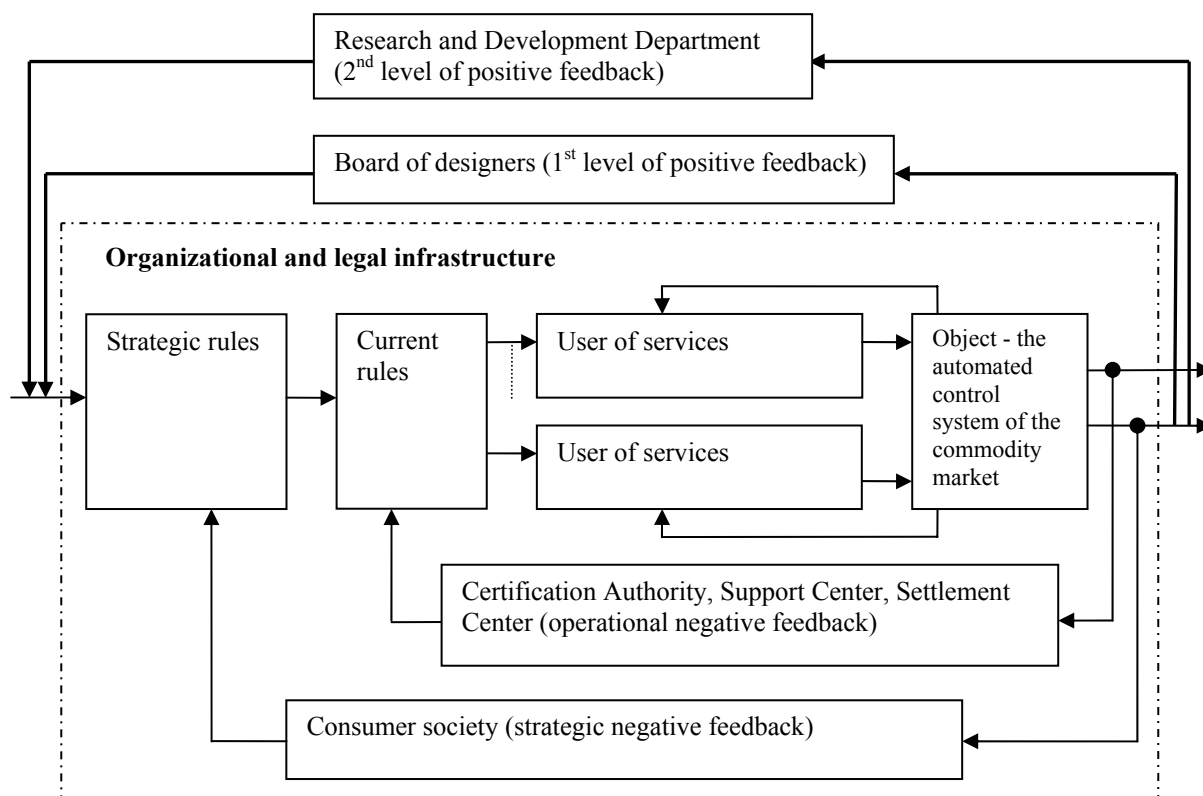
The preliminary results showed that the technology the Electronic commodity market system is universal for Russia and for any other coun-

try, and for international relations.

#### *Organizational-Legal Infrastructure of the Electronic commodity market system*

For Electronic commodity market system have been developed organizational-legal infrastructure based on the model of self-organizing system.

Fig. 2 shows the organizational and legal infrastructure of Electronic commodity market system.



**Fig. 2. Organizational and legal infrastructure of Electronic commodity market system**

In accordance with Russian legislation, members of the commodity market can establish a consumer society for creation, management and development of the Electronic commodity market system on conditions that one shareholder has one vote. In the consumer society can be involved simultaneously government, business and people. Shareholders are engaged in investing of the development and later in management of the Electronic commodity market system and receive dividends (cooperative payment).

Automated Control System (ACS) of the commodity market is owned by shareholders; strategic rules are governed by and developed on a parity basis.

Consumer society develops rules and automated control system of the commodity market.

The consumer society organizes operational feedback - establishes or connects organizations that act as support structure (Support centers, Certification Authorities and Settlement centers).

At the consumer society the board of designers is created. In the board of designers there are shareholders, developers and active system users. Function of the board of designers is the registration of deviations in the work of the system, both internal and external fluctuations, which can't be compensated by support structure in the operational negative feedback.

The results of the work of designers' board are the basis for the strategic negative feedback (for the consumer society). Consumer Society organizes the work of the strategic negative feedback and adapts the system.

R&D Department investigates the deviations in the work of the whole system, internal and external fluctuations, and develops projects of radical transformation of the system, its subsystems or external environments.

Thus, the direct relations (market transactions - current functioning of the system) in the Electronic commodity market system are carried out on the basis of the principles of competition of market subjects. Operational negative feedback (support of the current structure) is based on the principles of control of the Support structure. Strategic negative feedback (adaptation to changing external and internal conditions by changing the rules) is carried out on the basis of cooperative principles of market subjects.

Network organizational and legal structure of Electronic commodity market system is created as a network of consumer societies and their unions.

*Trust to Electronic commodity market system*

Using of information technology is associated with the issue of electronic trust (e-trust). E-trust consists of opportunities Electronic commodity market system to provide a range of indicators, in particular:

- Independence of the organizational legal structure, software, products of certification and data encryption from the narrow circle of private owners or the State, since Electronic commodity market system is built on the principles of consumer cooperation.

- Presence of technology, eliminating opportunistic behavior of the users of the system and providing risk minimization to lose the funds in electronic transactions. In Electronic commodity market system not only the buyer and seller are involved in the transactions, but also banks, warehouses, freight forwarders and insurers. Also the system contains statistics of previous transactions; mechanism of funds reservation for the transaction is used.

- Prevent of unauthorized viewing and distribution of content information that is sent, stored and processed.

Network of Consumer Societies should provide the minimum cost of access to the Electronic commodity market system.

In the presence of transnational organizational and legal structure above described technology of the Electronic system of the commodity market will be transnational. Because it will not be important what country the user is from. All the concluded transactions will have legal significance

and contain clear for everybody mechanism of implementation.

In Kazakhstan, Belarus, Ukraine, France, Austria, Germany, England, Spain, there are the similar laws on cooperatives, as in Russia.

For example Russian Consumer society can exercise the same functions as the Austrian cooperative with limited liability of its members (Genossenschaft mit beschränkter Haftung ihrer Mitglieder).

That allows to make preliminary conclusions about the possibility of the System implementation in the CIS (Commonwealth of Independent States) and the EU.

So the developed system is universal in the sense of the institutional model and technology. System can be implemented for using within a particular country, and for informational and economic exchange between countries.

The development of theoretical structural-functional model of self-organizing economic system is presented in this paper. The description of the processes of functioning, adaptation and development of self-organizing economic system is given.

As an example of the practical implementation the project of Electronic commodity market system is described.

To date, in Russia has been established organizational and legal prototype and has been developed the technology of the Electronic commodity market system.

By the end of 2011 it is planned to implement operational test of the Electronic system of the external legally significant document circulation - the basic technology of Electronic commodity market system.

It gives ground to make preliminary conclusion about feasibility of the structural-functional model of self-organizing economic system.

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